

## **DEVICE TO PREVENT THE EXTRACTION OF AN ANCHOR SCREW FOR AN OSTEOSYNTHESIS ELEMENT**

This present invention concerns the technical area of osteosynthesis in the general sense and of the spinal column in particular, and it covers, more precisely, a  
5 device to prevent the extraction of an anchor screw from an osteosynthesis element in the general sense, such as a plate for example.

In the current state of development, we are familiar with the use of a rigid osteosynthesis plate, designed to cover, at least partially, two consecutive vertebrae, in order to join them together. This osteosynthesis plate is provided with of holes or  
10 crosswise bores, each designed to take a screw intended to be anchored in the body of the vertebrae.

After the fitting of such osteosynthesis devices in patients, a phenomenon of separation or partial extraction of the anchor screws was observed. This leads to a loss of stability of the plate and is liable to cause lesions or injuries, in particular to  
15 organs located nearby.

A need has therefore arisen to guarantee the fixing of the anchor screws, in order to prevent them from pulling out of the osteosynthesis plate.

In an attempt to meet this need, the current state of development has proposed various technical solutions. For example, patent application FR 2 540 321 described  
20 an osteosynthesis device that includes a rigid backing plate intended to be secured to the front of the osteosynthesis plate, as a means to prevent the extraction of the anchor screws. This backing plate is designed to have a shape that is more or less the same as that of the osteosynthesis plate, so as to totally cover all of the heads of the anchor screws. The backing plate is secured to the osteosynthesis plate by means of a  
25 screw that is designed to screw into a thread tapped into the osteosynthesis plate. The backing plate therefore constitutes a butt-plate for the heads of the screws.

It must be assumed that the fitting of these extraction-prevention resources is a relatively lengthy operation to execute correctly, due to the process for positioning of the backing plate, followed by a procedure for screwing the backing plate onto the  
30 osteosynthesis plate. Apart from this, the screw for securing the backing plate to the osteosynthesis plate is liable to come loose, leading to separation of the backing plate in relation to the main plate, as well as separation of the anchor screws. Moreover, it

must be assumed that the use of a rigid backing plate represents a relatively bulky object, which is liable to lead to injuries or lesions.

The purpose of the invention is therefore to remedy the drawbacks described above by proposing a device to prevent the extraction of an anchor screw for an  
5 osteosynthesis element, designed to be a reliable and effective means of locking the anchor screw, while still being fast and easy to fit.

In order to attain this objective, the subject of the invention concerns a device to prevent the extraction of an anchor screw from an osteosynthesis element, where such a device includes:

- 10
- an anchor screw that includes a head which is extended by a threaded shaft,
  - and an osteosynthesis element with a hole to take the anchor screw.

According to the invention:

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- the anchor screw includes, at its head, at least two securing arms mounted elastically on the screw, so as to occupy a retracted position under the action of a radial force, and a locking position under the action of a lower radial force,
  - and at its screw holes, the osteosynthesis element includes a section for radial  
constraining of the securing arms, opening downstream in the direction of  
engagement of the screw, in a locking channel, so that during the screwing operation  
of the anchor screw, the securing arms initially occupy their retracted position due to  
20 the action exerted by the constraining section, and then their locking position by  
occupying the locking channel.

According to a preferred form of implementation, each securing arm is composed of a mobile rod, secured to the screw and extending, at rest, more or less parallel to the axis of the anchor screw and equipped with a locking lug located  
25 opposite to the fixing point of the securing arms.

Preferably, each securing arm is mounted to extend in relation to a notch created axially on the anchor screw to allow the securing arms to occupy their retracted position.

According to an advantageous characteristic of the invention, the mounting  
30 position of the securing arms on the anchor screw, and the position of the locking channel on the osteosynthesis element, are such that the anchor screw occupies more or less its final fitted position when the securing arms occupy their locking position.

According to a preferred characteristic of implementation, each securing arm includes an axial grasping extension that projects in relation to the head of the anchor screw.

5      Advantageously, the head of the anchor screw is provided with a means by which it can be rotated.

Another purpose of the invention is to propose an instrument for the removal of an anchor screw forming part of an extraction-prevention device according to the invention. This instrument includes a handle fitted with:

- a device to fit onto the means employed to rotate the anchor screw,
- 10      ▪ an unlocking device suitable for exerting a radial force on the securing arms, in order to bring them to their retracted position.

Advantageously, the unlocking device exerts a radial force on the grasping extensions of the securing arms.

15      Various other characteristics emerge from of the description provided above with reference to the appended drawings which show, by way of non-limited examples, forms of implementation of the subject of the invention.

Figure 1 is a view, in partial perspective, showing an extraction-prevention device according to the invention.

20      Figure 2 is a view, in section-elevation, showing an extraction device in its mounted position.

Figure 3 is a view, in section-elevation, showing an extraction-prevention device combined with an instrument for removal of the anchor screw.

25      As illustrated in the figures, the invention concerns a device 1 employed to prevent the extraction of a bone-anchor screw 2, used to secure an osteosynthesis element 3, in the general sense, such as a plate in the illustrated example. The anchor screw 2 includes a head 4 extended by a threaded shaft 5. Conventionally, the head 4 is provided with a means 7 by which it can be rotated. For example, this means by which the screw can be rotated 7 can be composed of a prismatic slot opening onto the top surface 8 of the screw head.

30      According to an advantageous characteristic of the invention, the anchor screw 2 includes, at its head 4, at least two securing arms 11, mounted in the illustrated example diametrically opposite to each other on the screw 2. The securing arms 11

are mounted elastically to occupy a retracted position under the action of a radial force, and a locking position under the action of a radial force of lower value in relation to that leading to their placement in the retracted position. It should be noted that in the locking position, the radial force exerted on the securing arms **11** can be of zero value or not.

As can be seen more precisely from **fig. 1**, each securing arm **11** is composed, for example, of a mobile rod **13** secured to the screw, and extending at rest, that is to say when it is not subject to the action of external forces, more or less parallel to the axis of the anchor screw **2**. Each securing arm **11** is equipped, opposite to its fixing point, with a locking lug **15**, whose function will be seen more precisely in the remainder of the description.

Preferably, each locking lug **15** extends radially from the mobile rod **13**, presenting, at the side turned toward the free end of the screw **2**, an engagement ramp **16** inclined in the direction of the free end of the screw. Thus, in the rest position, the locking lugs **15** extend in projection in relation to the threaded shaft **5** of the anchor screw **2**.

Each securing arm **11** is mounted to extend, in relation to a notch **18** created axially on the anchor screw **2**, to allow the securing arms **11** to occupy their retracted position. It should be understood that the application of a radial force on the securing arms **11** forces them to close up diametrically, so that they occupy a reduced width in relation to the width occupied in their locking or rest position.

According to another advantageous characteristic of the invention, the osteosynthesis element **3** includes at least one hole or bore for passage **21** of the anchor screw **2**. This screw hole **21** includes a radial constraint section **23** for the securing arms **11**, so as to force the arms into their retracted position. It should be understood that this section **23** is of a dimension that is less than the delimited width between the securing arms **11**, when the latter occupy their locking or rest position. Of course, this section **23** is of a dimension that is suitable to allow the passage of the anchor screw **2**. This radial constraint section **23** opens downstream, in the direction of engagement of the screw **2**, in a locking channel **28** in which the securing arms **11** occupy their locking position. It should therefore be understood that the locking channel **28** is of a radial dimension that is greater than section **23** and suitable to

allow the securing arms 11 to occupy their rest position. In this position of engagement of the securing arms 11 inside the locking channel 28, the anchor screw 2 cannot come loose in relation to the osteosynthesis element 3 since such loosening is prevented by the constraining of securing arms 11 against the bottom of the locking channel 28, delimited by radial section 23. Preferably, the locking channel 28 takes the form of a groove that extends over the whole periphery of the screw hole 21.

The operation of the anti-extraction device 1 according to the invention flows directly from the above description. After the positioning of the osteosynthesis element 3, an anchor screw 2 is fitted through the bore 21 created in the osteosynthesis element 3. In the final stage of the tightening operation on the screw 2, the securing arms 11 are constrained radially by the constraint section 23 to close up so that they occupy their retracted position. Continuing the tightening operation on the screw 2 brings the securing arms 11, and more precisely the lugs 15 to engage in the locking channel 28 so that the securing arms 11 separate radially to occupy their locking position. It should be noted that in this position of engagement, the securing arms 11 may or may not be subjected to radial constraint. The securing arms 11 are thus clicked into the locking channel 28 so that the anchor screw 2 will be locked to the osteosynthesis element 3 in both directions. It should be noted, and as can be seen more precisely from fig. 3, that the mounting position of the securing arms 11 on the anchor screw 2 and the position of the locking channel 28 on the osteosynthesis element 3 is such that the anchor screw 2 occupies more or less its final fitted position when the securing arms 11 are in their locking position. In this position, the top surface 8 of the head of the anchor screw is more or less recessed in relation to the outer face of the osteosynthesis element 3.

In the above description, the anchor screw 2 includes two securing arms 11 extending diametrically opposite to each other. Of course, the anchor screw 2 can include a different number of securing arms positioned in an appropriate manner on the periphery of the anchor screw. Likewise, the securing arms can extend over a peripheral range of varying size.

According to a preferred characteristic of the invention, each securing arm 11 includes an axial grasping extension 31 that projects in relation to the head of the

anchor screw and, in particular, in relation to the top surface 8. Such extensions 31 can advantageously be forced to close up by means of an instrument 40 to allow removal of the anchor screw 2 where necessary. This instrument 40 includes a handle not shown that is extended by a rod 41 which in turn is provided with a means 42  
5 that fits onto the means 7 used to rotate the anchor screw 2. Such an instrument 40 is also fitted with an unlocking device 43 that is able to exert a radial force on the securing arms 11, in order bring them to their retracted position so as to allow the unscrewing operation.

In the illustrated example, such an unlocking device 43 is composed of two  
10 mobile fingers 45, capable of being brought together radially by means of a tube 46 mounted to slide axially so as to allow the closure of the mobile fingers 45, so that they exert a radial force on the grasping extensions 31 of the securing arms 11. In this position, the instrument 40 can then be used to rotate the anchor screw in its unscrew direction, so that it can be removed from the osteosynthesis element 3. Such  
15 removal is possible to the extent that, during this unscrewing operation, the securing arms 11 are held in their retracted position to pass beyond the radial constraint section 23.

The invention is not limited only to the examples described and illustrated, since various modifications can be made to it without moving outside of its framework.